

## **REMARKS**

Claim 1 has been amended herein. Support for Claim 1 as amended is found Claim 2 as originally filed. No new matter is added. Claims 1-14, 17-24, and 45-49 remain in the application. Favorable reconsideration is respectfully requested.

The following remarks address the issues presented in the Office Action in the order of their appearance.

### **Rejection of Claims 1-14, 17-24, and 45-49 Under §102(e) or, Alternatively, Under §103(a) in View of Reichman et al., U.S. Patent No. 6,607,707:**

This rejection is believed to be overcome by the Combined Rule 131/132 Declaration of Inventors Randy D. Cortright and James A. Dumesic, submitted herewith. The present application is a continuation of U.S. application Serial No. 09/998,552, filed November 29, 2001 (and now issued as U.S. Patent No. 6,699,457). Thus, the earliest effective filing date of the present application is November 29, 2001.

The effective date of the Reichmann et al. patent is its filing date, August 15, 2001, a date that is less than one year prior to the effective filing date of the present application. Thus, the Reichmann et al. patent can be removed as available prior art by a proper showing under Rule 131 and/or Rule 132. Applicants respectfully submit that the attached Declaration of co-inventors Cortright and Dumesic provides such a showing.

Specifically, in paragraphs 1 and 2 of their Declaration, Drs. Cortright and Dumesic declare that they are both co-inventors of the presently claimed invention and that they are familiar with the Reichmann et al. patent. As noted in the Declaration, the Reichmann et al. patent was filed on August 15, 2001, a date which is less than one year prior to the effective filing date (November 29, 2001) of the present application. See paragraph 3 of the Declaration.

In paragraph 4 of their Declaration, Drs. Cortright and Dumesic state that prior to August 15, 2001, they jointly conceived the idea of producing hydrogen at low temperatures via steam-reforming of oxygenated hydrocarbons. They then prepared

a confidential presentation for the Wisconsin Alumni Research Foundation (WARF), the assignee of the present application. (NB: While not referenced in the Declaration, the assignment of this application from the inventors to WARF is recorded at reel 012651, Frame 0822.) Attached as Exhibit A to the Declaration is a true and complete copy of the presentation that Drs. Cortight and Dumesic presented to WARF during a confidential meeting that took place at WARF's offices in Madison, Wisconsin, prior to August 15, 2001.

Exhibit A of the Declaration opens with a brief history of steam reforming of hydrocarbons to yield hydrogen and the uses for the resulting hydrogen. As noted at page A-1, for most industrial uses, including for ammonia synthesis, for oil refining, and for use as a fuel in fuel cells, hydrogen must have very low impurity levels of sulfur, CO, CO<sub>2</sub>, and water. Pages A-2 to A-6 of Exhibit A present an overview of the conventional steam reforming process, including a description of the water-gas shift (WGS) reaction. Page A-7 of Exhibit A outlines the disadvantages of conventional steam reforming of hydrocarbons (*e.g.*, the hydrogen produced is contaminated with sulfur and CO; temperatures greater than 500 °C are required; the hydrocarbon reactants are highly flammable.)

Beginning at page A-8 of Exhibit A is a detailed description of the invention that is now recited in the claims pending in the present application. Specifically, at page A-8, the now-claimed invention is briefly described as using oxygenated compounds such as ethanol, ethylene glycol, glycerol, and sorbitol (all of which are water-soluble oxygenated hydrocarbons having at least two carbon atoms as required by Claim 1) and reforming these compounds at low temperatures to yield hydrogen. Pages A-9 to A-12 describe using oxygenated hydrocarbon fuels have a C-to-O ratio of 1-to-1 and the favorable equilibrium constants that are obtained using these reactants. See the graphs at pages A-12 and A-13. Such compounds include ethylene glycol and sorbitol. The graph at page A-13 compares the equilibria between reforming of oxygenated compounds according to the present invention versus conventional reforming of hydrocarbons. The graph at page A-13 demonstrates that

oxygenated compounds as recited in Claim 1 of the present application can be reformed to yield hydrogen at temperatures much lower than the temperatures required to reform hydrocarbons. Pages A-14 and A-15 describe the effect of temperature for steam reforming of oxygenates. As illustrated in the graph at page A-14, the reaction thermodynamics are favorable for the reforming of all oxygenates.

The remainder of Exhibit A of the Declaration, at pages A-16 to A-21, is a discussion of the effects of various catalysts, including catalysts containing the Group VIII transition metals ruthenium, rhodium, nickel, platinum, palladium, iridium, cobalt, and iron. See the graph at page A-17. As noted in the Declaration, this graph is significant because it clearly shows the production of hydrogen by reforming ethylene glycol, in the presence of Group VIII transition metals, at a temperature of only 250°C. The graph at page A-18 shows the corresponding results for a nickel catalyst supported on either a silica support (the red trace) or a mixed magnesia/alumina support (the blue trace). In both instances, hydrogen was produced. Pages A-19, A-20, and A-21 show corresponding traces for ruthenium/palladium catalysts, nickel/platinum catalysts, and nickel/palladium catalysts, respectively. In all instances, hydrogen was produced.

As stated in paragraph 9 of the Declaration, the work described in the Declaration was performed in the United States, on a date prior to August 15, 2001. The Declaration was signed under penalty of perjury under 18 USC 1001, as stated at paragraph 10 of the Declaration.

In view of the Declaration, Applicants respectfully submit that they had conceived and reduced to practice the presently claimed invention prior to the filing date of the Reichmann et al. patent. Thus, the Reichmann et al. patent has been antedated and is no longer available as prior art with respect to the present application. Applicants therefore respectfully request that the rejection of Claims 1-14, 17-24, and 45-49 under §102(e) or, alternatively, under §103(a) in view of Reichman et al. has been overcome. Withdrawal of the rejection is now requested.

**Rejection of Claims 1-14, 17-24, and 45-49 Under §102(e) or, Alternatively, Under §103(a) in View of Lomax, Jr. et al., U.S. Patent No. 6,623,719:**

This rejection is believed to have been overcome, in part, by appropriate amendment to Claim 1, and is, in part, respectfully traversed.

As applied to Claims 1, 5-10, 19-24, this rejection is believed to have been overcome by amending Claim 1 to recite that the reaction takes place at a temperature not greater than 450°C. This amendment is explicitly supported by the language of Claim 2 as originally submitted.

As applied to Claims 2-4, 11-14, 17, 18, and 45-49 as they presently stand (and Claims 1, 5-10, 19-24 as amended herein), this rejection is respectfully traversed because each of these claims includes an upper temperature limitation that is neither suggested, motivated, or taught by the Lomax, Jr. et al. patent. Specifically, Lomax, Jr. et al. explicitly indicate that their reaction must occur at significantly elevated temperatures, namely between 500°C and 900°C. See Lomax, Jr. et al. in the paragraph spanning columns 15 and 16.

Regarding the rejection under §102, to anticipate a claim, the applied reference must explicitly or inherently disclose the invention as claimed. Under the doctrine of inherent disclosure, *implications* **do not** count. The reference must either **explicitly disclose** the invention as claimed or inherently disclose the invention as claimed as a **necessary, inexorable, and inescapable result** of the teaching of the reference. Possibilities, probabilities and/or *implications* are insufficient to support a rejection under §102(e). For purposes of §102, either the applied reference discloses the entire invention as claimed or it does not.

In the present situation, because the Office has effectively admitted that Lomax, Jr. et al. **do not** explicitly disclose running their reaction at less than 500°C, all that remains is whether the reference **inherently** discloses running the reaction at such a temperature. The reference clearly **does not** inherently disclose running it at a temperature below 500°C because if it did, no *implication* would be required. It remains entirely uncertain from the explicit teaching of Lomax, Jr. et al. whether or

not his reaction will even work at temperatures less than 500°C. As a result, the reference clearly does not inherently anticipate the present claims.

Applicants therefore submit that the rejection of Claims 1-14, 17-24, and 45-49 (as amended herein) under §102(e) in view of Lomax Jr. et al. is clearly improper.

Addressing the rejection under §103, Applicants explicitly traverse the Office's position articulated at the top of page 4 of the Office Action: *i.e.*, that by stating a "preferred" temperature range of between 500°C and 900°C, Lomax, Jr. et al. somehow imply that the reaction will work at temperatures below 500°C. In fact, the exact opposite conclusion is warranted. Lomax, Jr. et al.'s least preferred temperature range is between 500°C to 900°C. Note that at the top of column 16, Lomax, Jr. et al. go on to state that a more preferred temperature range is between 600°C and 800°C. Even further, Lomax Jr. et al. go on to state that a still more preferred temperature range is between 700°C and 800°C. Note that Lomax, Jr.'s preferred low-end temperature is going up (from 500°C, to 600°C, to 700°C), not down. The explicit teaching of Lomax, Jr. et al. is that a temperature at or higher than 500°C is preferred.

The *implication* conveyed by Lomax, Jr. (if any) is clearly that a temperature below 500°C is not technologically advantageous. Lomax, Jr. thus teaches away from the present invention, not toward it. Lomax explicitly teaches that reaction temperatures above 500°C are best. The only *implication* that can be drawn from this explicit teaching is that running Lomax' reaction at 500°C is the low-end range, 600°C is better, 700°C is better still, and 800°C is better yet. This series clearly *implies* that running the reaction at 900°C is likely better than running it at 800°C. Applicants thus submit that the Office has failed to establish a prima facie case of obviousness with respect to these claims because rather than suggesting the claimed invention, Lomax, Jr. et al. teach away from the claimed invention. See, for example, *In re Hedges*, 228 USPQ 685,687 (Fed. Cir. 1986).

In short, contrary to the Office's position articulated at the top of page 4 of the Office Action, Lomax, Jr. et al. in no way teach, suggest, or imply in any way that their reaction will function at temperatures below 500°C.

Applicants additionally (and respectfully) submit that the only way the Office can come to its conclusion regarding the *implications* of the Lomax, Jr. et al. reference is by improperly using the Applicants' own disclosure. As noted above, Lomax Jr. et al. **do not disclose** running their reaction at a temperature below 500°C. And the only *implication* to be drawn from Lomax Jr. et al.'s explicitly stated preferred lower-end temperatures is that running the reaction at a temperature of from 700°C to 800°C is far better than running the reaction at 500°C. The only motivation or suggestion of running such a reaction at a temperature lower than 500°C is provided by Applicants' own disclosure. However, the Office is not free to use the Applicants' disclosure to supply the suggestion or motivation that is lacking in the applied reference.

Thus, as applied to Claims 2-4, 11-14, 17, 18, and 45-49, and Claims 1, 5-10, 19-24 as amended herein, Applicants submit that the Office has not established a *prima facie* case of obvious in view of the Lomax, Jr. et al. reference. Applicants therefore request that the rejection of Claims 1-14, 17-24, and 45-49 in view of the Lomax, Jr. et al. reference be withdrawn.

**Rejection of Claims 1-14, 17-24, and 45-49 Under §103(a) Over Lomax, Jr. et al. in View of Reichmann et al.:**

This rejection is believed to have been overcome by the Combined Rule 131/132 Declaration of Inventors Cortright and Dumesic, filed herewith and discussed hereinabove. The earlier discussion of the attached Declaration is repeated herein.

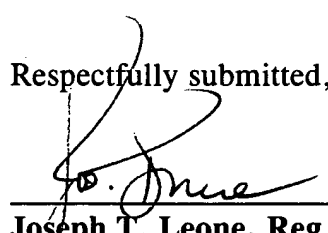
Because this rejection explicitly relies upon the Reichmann et al. patent, and because the Reichmann et al. patent has been antedated by the attached Declaration (and is thus not available prior art with respect to this application), Applicants respectfully submit that this rejection has been overcome.

In view of the Combined Rule 131/132 Declaration submitted herewith, Applicants request that the rejection of Claims 1-14, 17-24, and 45-49 under §103(a) over Lomax, Jr. et al. in view of Reichmann et al. be withdrawn.

**CONCLUSION**

Applicants submit that the application is now in condition for allowance. Early notification of such action is earnestly solicited.

Respectfully submitted,

  
Joseph T. Leone, Reg. No. 37,170  
DEWITT ROSS & STEVENS S.C.  
8000 Excelsior Drive, Suite 401  
Madison, Wisconsin 53717-1914  
Telephone: (608) 831-2100  
Facsimile: (608) 831-2106